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ABSTRACT

This publication highlights information about the energy problem and indicates some possible solutions. Americans must find new energy sources and more efficient ways to utilize existing energy supplies. The National Wildlife Federation urges conservation of existing fuel supplies, exploration of new potential energy sources, adaption of some energy sources to lessen their negative affects, and adaption of personal living habits. (Author/BW)

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YOU'LL

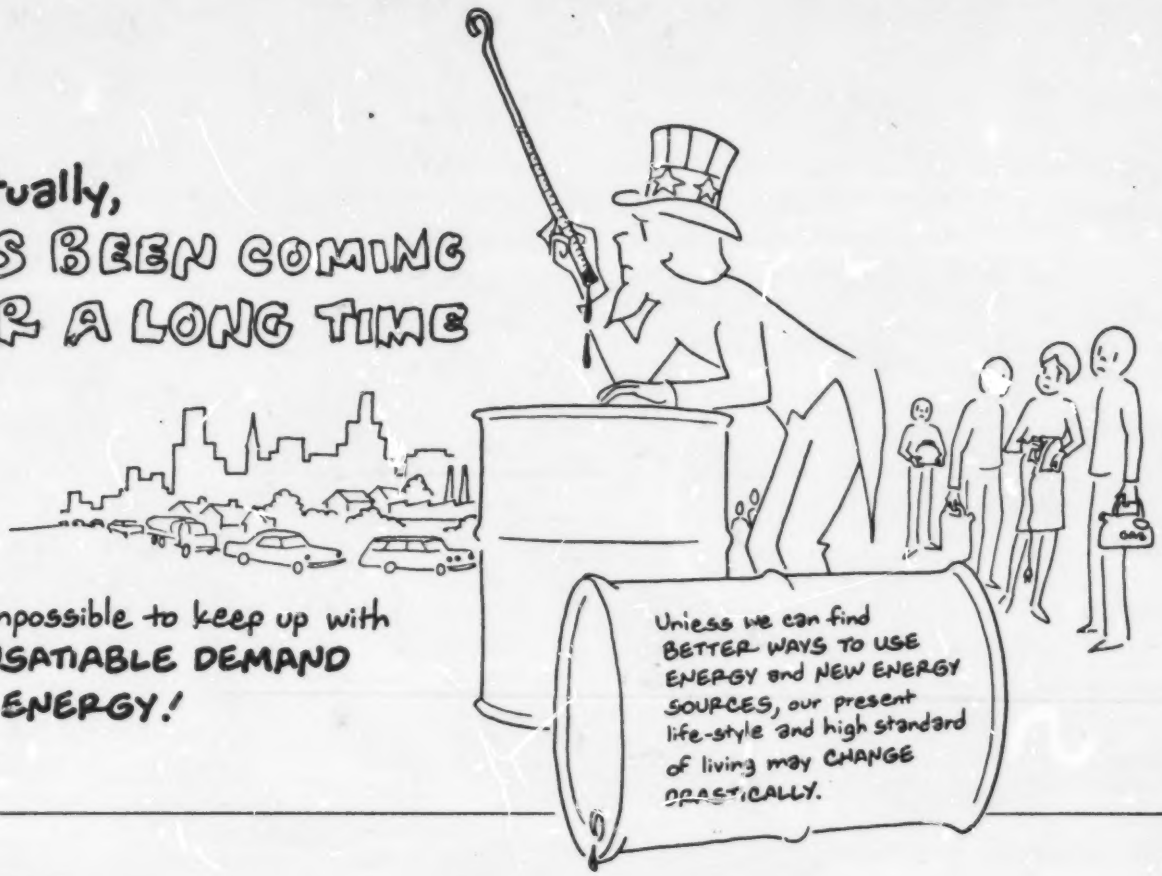
A GROWING NATIONAL PROBLEM

A 16-page special report, with glossary.

National Wildlife Federation
1412 16TH ST., N.W., WASHINGTON, D.C. 20036

SE 031 930

Actually, IT'S BEEN COMING FOR A LONG TIME


It's impossible to keep up with an INSATIABLE DEMAND FOR ENERGY!
Unless we can find BETTER WAYS TO USE ENERGY and NEW ENERGY SOURCES, our present life-style and high standard of living may CHANGE DRASTICALLY.

IN THE PAST

Energy was cheap and we used it wastefully, thoughtlessly. Our energy consumption rose 4% per year between 1960 and 1973 – a total of over 70%. This demand has cut deeply into our reserves of oil and natural gas. Those days of cheap, abundant energy are gone forever.

TODAY

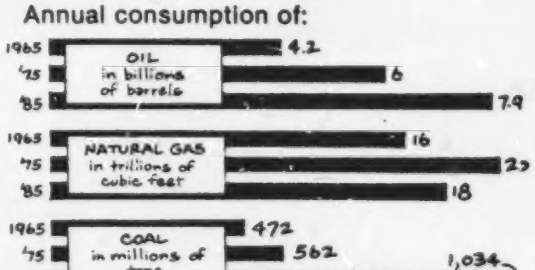
Oil and gas are getting harder to find and more expensive, too. Even a modest rise in consumption will soon exhaust our supplies. Although rapidly rising prices and increased conservation efforts have slowed consumption, more energy is needed to support growing population and economic expansion.

IN THE FUTURE

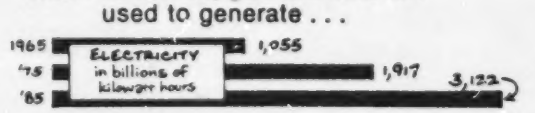
Even our vast reserves of coal could be rapidly depleted. If our use of coal climbed 6% a year (as called for by some federal energy planners) our consumption would double in 12 years and quadruple in 24.

Although we Americans produce 35% of the gross world product, we make up only 6% of the world's population and CONSUME 32% OF TOTAL WORLD ENERGY!

Annual consumption of:



Much of this oil, gas and coal are used to generate . . .



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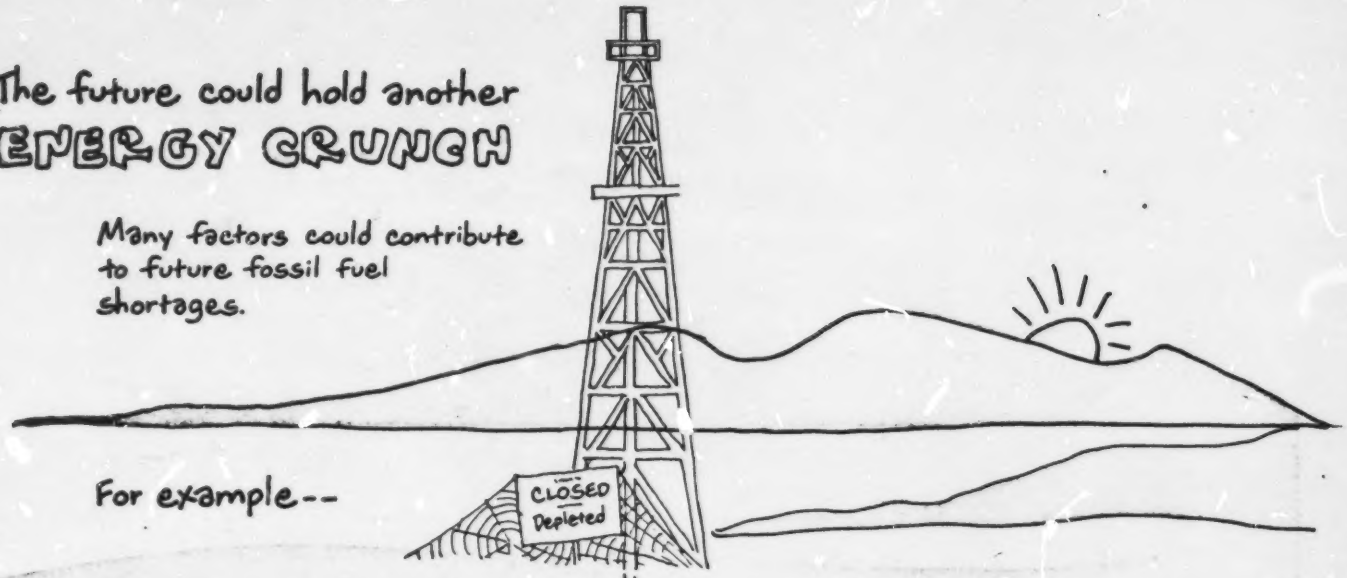
The future could hold another ENERGY CRUNCH

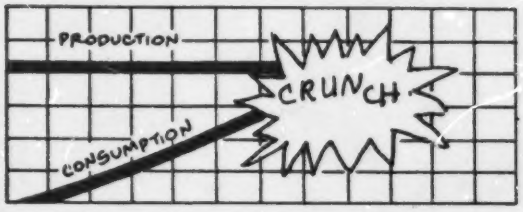
Many factors could contribute to future fossil fuel shortages.



For example--

LIMITED PRODUCTION CAPACITY

Our production of oil and gas has leveled off, while demand continues to climb.



At our present consumption rate, we could be importing around 13 million barrels of oil a day by 1985 (vs. 9 million a day in 1977). This would make us dangerously dependent on foreign nations for our energy. And paying for it would seriously strain our economy.

LAGGING EXPLORATION

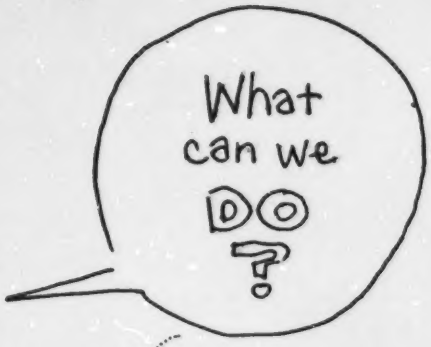
High prices have stimulated the search for new oil and gas supplies. But much of the drilling is near established fields. Exploration in new areas, which would add to our reserves, is lacking.

OVER-DEPENDENCE ON FOSSIL FUELS

The more we rely on our fossil fuels, the more quickly our fossil-fuel reserves will shrink. As oil and gas output declines and energy demand continues to climb, we must find alternatives.

INTERNATIONAL COMPETITION

If the growth in demand for fossil fuels exceeds the production capacities of oil-exporting nations, there will be intense competition for diminishing reserves. The stage could be set for worldwide social and economic upheaval.



We must begin **NOW** to find new energy sources and better ways to use energy.

To start, we should--

CONSERVE

We have to reduce oil imports and make our existing fuel supplies last longer by using energy more wisely and more efficiently.

EXPLORE

New potential sources of oil and gas must be found, at home and abroad, while protecting the environment. This can help fill the energy gap until new energy sources are developed.

ADAPT

Ways are being found to burn coal with minimum environmental damage. For example, we are learning to treat coal under heat and pressure to produce clean gas and synthetic oil. And burning coal in new "fluidized bed" boilers removes most of the pollutants.

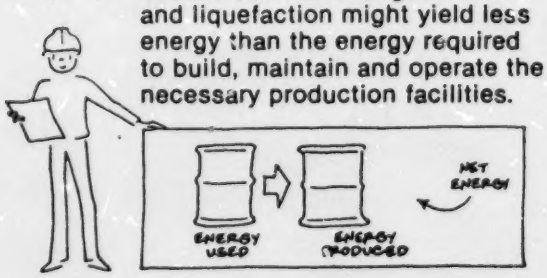
INNOVATE

New and sometimes unconventional ideas must be tried. Burning household trash can provide heat and electricity (Saugus, Mass. and Ames, Iowa are doing it today). Garbage is also a "mine" of scrap metals that can be recycled for a fraction of the cost and energy needed to process virgin ores.

For **LONGE-RANGE** solutions, we must develop alternatives to existing fuels. In doing so, we must--

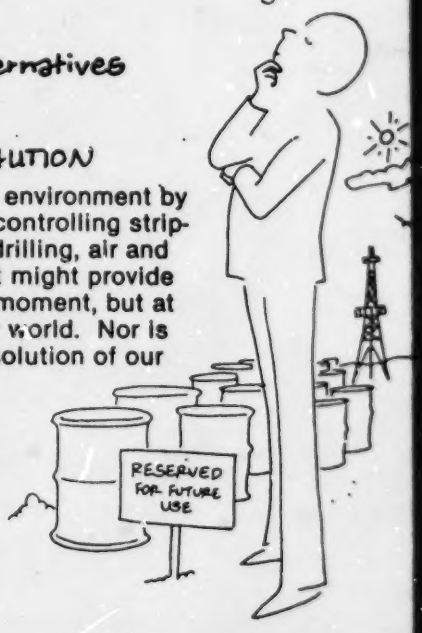
USE THE "NET ENERGY" CONCEPT

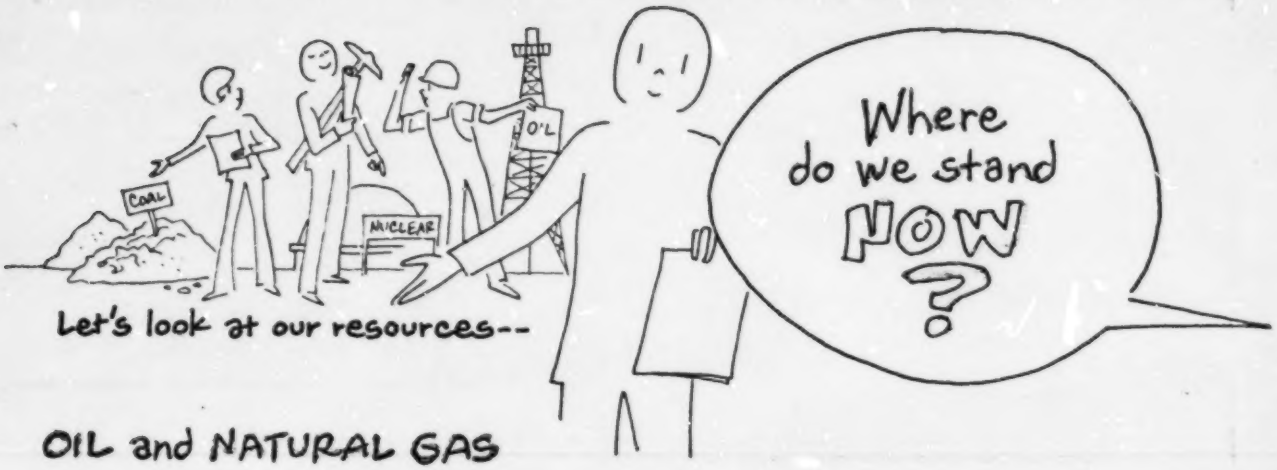
"Net energy" is the amount of energy produced minus the energy needed to produce it. Some potential fuel sources such as oil shale and tar sands, or new processes such as coal gasification and liquefaction might yield less energy than the energy required to build, maintain and operate the necessary production facilities.



PROCEED WITH CAUTION

- We can't sell out the environment by weakening our laws controlling strip-mining, offshore oil drilling, air and water pollution. That might provide for the needs of the moment, but at too high a risk to our world. Nor is it necessary for the solution of our energy problems.
- We must not use dwindling supplies of petroleum (vital because of its unique properties) where alternative fuels are available.





OIL and NATURAL GAS

We've put most of our fuel burden (74%) on oil and natural gas. They took millions of years to make, are in limited supply, and are becoming harder to find.

PETROLEUM is ESPECIALLY IMPORTANT since it's the overwhelmingly dominant fuel today for cars, trucks and airplanes. Oil and natural gas are also vital in the manufacture of many products such as fertilizers, fibers, plastics and pharmaceuticals.

OIL

Production in the U.S. hit a high point in 1970 (11.3 million barrels a day). Since then, our output has declined. Even with discoveries of major new oil fields in Alaska and offshore, production won't return to the peak levels of the past. At best, it will stabilize for a number of years. Sooner or later – no one really knows exactly when – our oil resources will substantially decline.

NATURAL GAS

The situation is much the same as with oil. As prices rise, and it becomes profitable to extract the less accessible deposits, new supplies will be found. However, many experts believe we have less gas than oil . . . so we're likely to run short sooner.

IMPORTS WILL EASE THE STRAIN

But foreign demand is also sure to go up, while world oil and gas production is expected to reach its peak in several decades, and then start to wane.

COAL

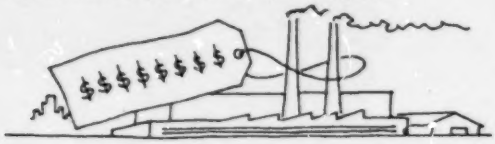
The U.S. has vast reserves--enough to last 500 years or longer at present usage rates. Only about 19% of our energy is now supplied by coal.

The government wants to double this by substituting more coal for oil and natural gas to generate electricity.

However, it won't be easy, because of--

EXPENSIVE TECHNIQUES

To meet clean air regulations, pollutants in coal must be removed with costly devices called "stack gas scrubbers," or by using expensive new gasification, liquefaction, or other techniques.



POSSIBLE CLIMATE CHANGES

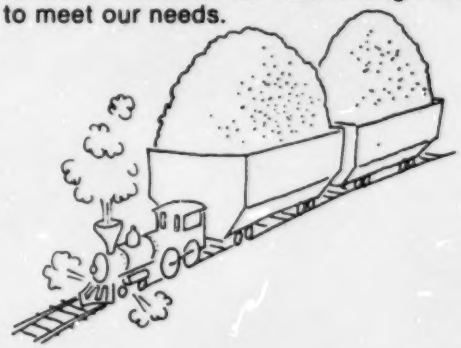
There are also fears that if too much coal is burned our climate might be affected.

POLLUTION PROBLEMS

Burning much greater amounts of coal would worsen the "acid rain" problem. The hot fumes from smokestacks react with moisture in the atmosphere to form sulfuric acid, which returns to earth as acid rain -- with devastating effects on plant and animal life.

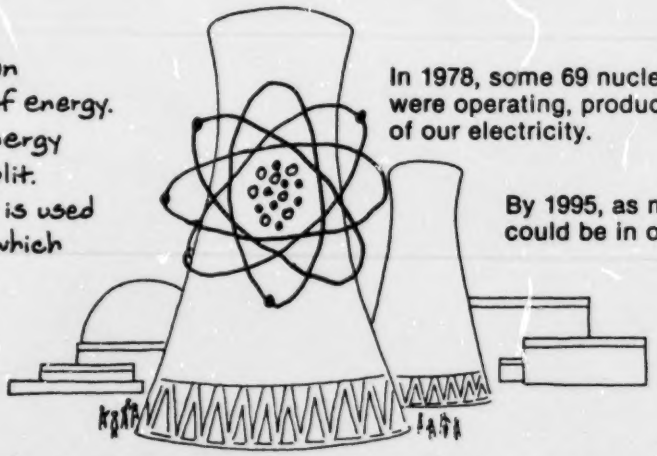
TRANSPORTATION PROBLEMS

There is also the question of whether our rundown railroads can haul enough coal to meet our needs.



NUCLEAR FISSION

Nuclear power is an important source of energy. Fission releases energy when atoms are split. Resulting high heat is used to produce steam, which in turn generates electricity.



In 1978, some 69 nuclear power plants were operating, producing about 12% of our electricity.

By 1995, as many as 200 could be in operation.

But, nuclear power won't grow as fast as expected, due to--

SAFETY, RELIABILITY CONCERNS

Reactors have proven to be less reliable than expected; the debate over how safe nuclear reactors are rages on.

DISPOSAL PROBLEMS

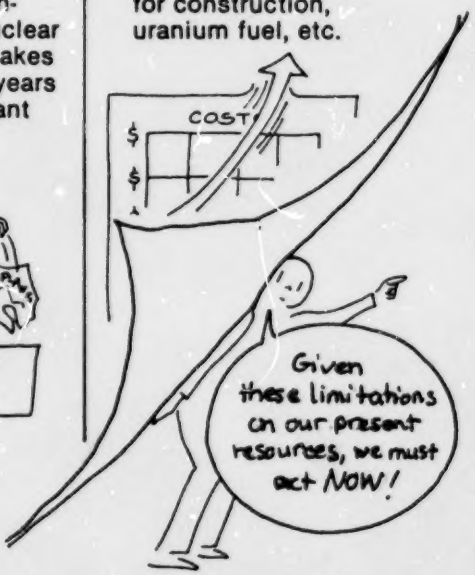
The still unsolved dilemma of how to dispose of highly radioactive wastes is a serious problem.

CONSTRUCTION DELAYS

Utilities have lost some of their enthusiasm for nuclear power since it takes as much as 12 years to put a new plant into operation.

HIGH EXPENSES

Costs have soared for construction, uranium fuel, etc.



NEEDED:
CONSERVATION

As much as 30-50% of the energy consumed in the U.S. is wasted.

Because energy was cheap in the past, we built inefficient cars, inefficient buildings, inefficient factories.

Because we used energy wastefully, the opportunities for saving energy now are great, and the reasons are compelling.

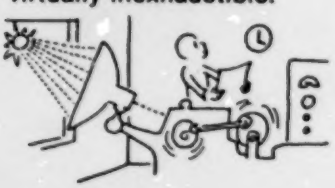
Conservation can--

STRETCH OUR PRESENT SUPPLIES

Conservation adds to the available energy supplies just as effectively as drilling new oil wells or putting up new power plants.

BUY US TIME

We must learn to conserve our remaining fossil fuels while there's still enough time to both expand our existing sources of energy and develop long-range alternatives – some of them virtually inexhaustible.

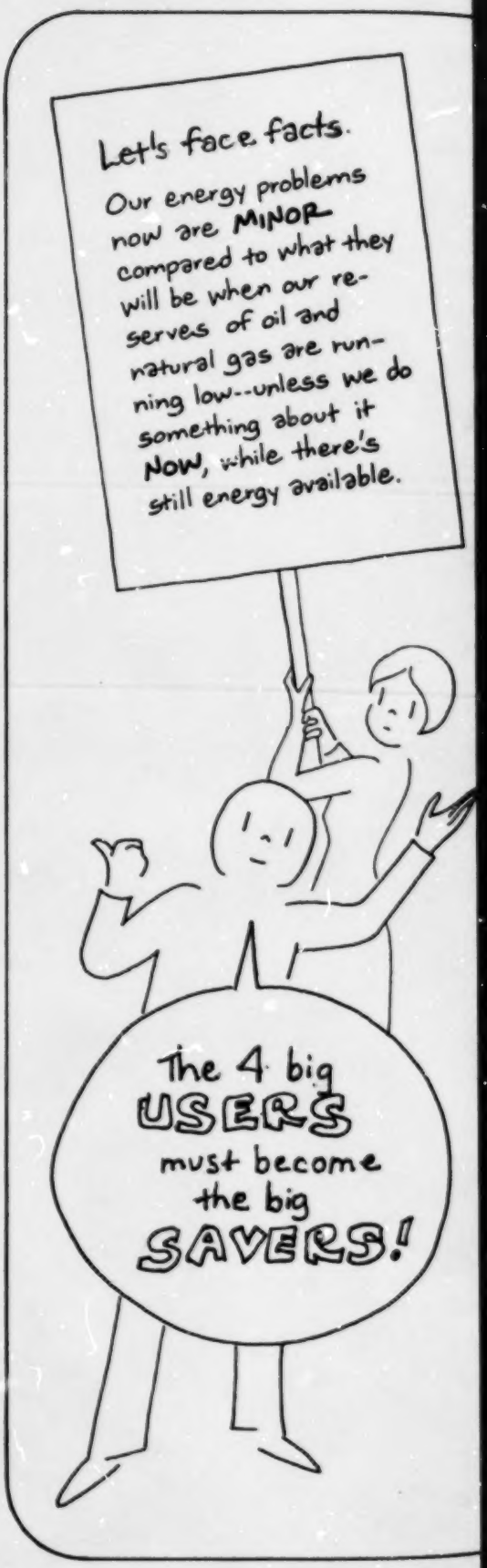


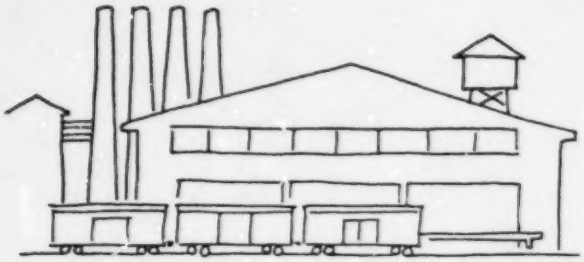
SAVE US MONEY

Compared to drilling new wells or putting up new power plants, conservation is cheaper, faster and better for the environment. The experts say we can get the energy equivalent of a barrel of oil through conservation for as little as $1.50 . . . a savings of nearly 90% over the world price!

LESSEN OUR DEPENDENCE ON FOREIGN OIL SUPPLIES

Every barrel of oil we save is one less we have to import, thus bolstering our security and economy. The money you save by conserving, often with little or no expense, can help you offset the rising cost of fuel.


Let's face facts.
Our energy problems now are MINOR compared to what they will be when our reserves of oil and natural gas are running low--unless we do something about it NOW, while there's still energy available.
The 4 big USERS must become the big SAVERS!



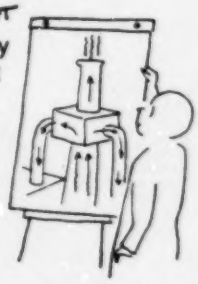
❶ INDUSTRY

accounts for 30% of our total energy consumption.

Savings can be made through--

RECAPTURING WASTE HEAT

About half the energy used by industry is lost as waste heat that could be recaptured to warm buildings and augment operations. Conservation could cut consumption by 20% (the equivalent of 67 million barrels of oil annually) by the mid-1980s.



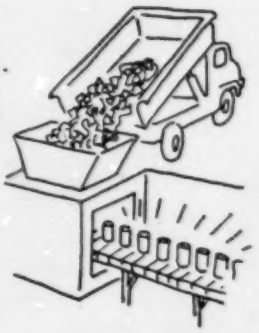
INCREASING EFFICIENCY

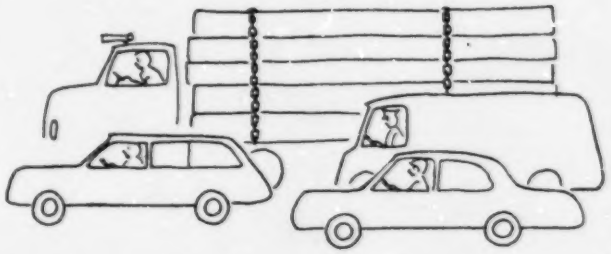
Better housekeeping (shutting large factory doors, lowering thermostats, etc.) can reduce fuel bills by 15%.

More efficient processes can save, too. A new refining process in the aluminum industry (the largest user of electricity) can cut consumption by 50%.

RECYCLING WASTES

Recycling requires less energy than mining and processing virgin materials. Refining scrap aluminum takes only about 5% of the energy needed to process raw bauxite.





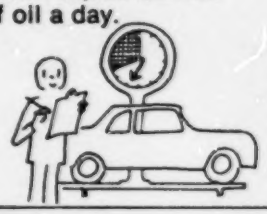
❷ TRANSPORTATION

accounts for 25% of our total energy consumption.

Savings can be made through--

REDUCING AUTO SIZE WEIGHT

Each 400 lb. weight reduction improves performance by 1 mile per gallon. New mileage requirements for American cars (an average 20 mpg by 1980 -- over 40% better than 1974) will save 700,000 barrels of oil a day.

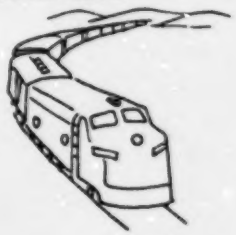


IMPROVING COMMUTER HABITS

Raising the average passenger load of the typical 5-passenger commuting vehicle from 1.2 to 1.6 passengers could save 440,000 barrels of oil a day.

USING RAILROADS MORE

Railroads can haul freight over long distances using only one quarter the energy per ton/mile that trucks need.



ENCOURAGING MASS TRANSIT

Buses or trains use less than half as much energy per passenger mile as private autos.

❸ HOMES and OFFICES account for 24% of our total energy consumption.

Savings can be made through--

INCREASING HOME INSULATION

Most American homes are energy wasters. By adding insulation to the attic floor of the typical house, heating bills can be reduced by about 20%. Installing storm windows and doors can save another 15%. Setting back the thermostat six degrees can save another 15%.

USING MORE EFFICIENT APPLIANCES

More efficient household appliances, especially water heaters, refrigerators and air conditioners, use much less energy. Manufacturers now display a model's efficiency and the amount of energy it consumes yearly. You can buy based on lifetime energy cost, as well as price.

BETTER ENERGY MANAGEMENT

Better energy management in office buildings is reducing heating and cooling expenses by 30 to 50%. Some new office buildings, designed for energy efficiency, use half the energy of older buildings of the same size.

By building dwellings partially or wholly underground, for example, cooling and heating costs can be cut 50 to 75%.

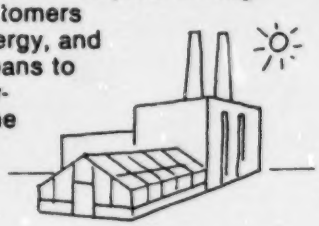
❹ UTILITIES account for 21% of our total energy consumption.

Savings can be made through--

MORE MODERN METHODS

Salvaging heat that's now lost when power is generated could save much energy. Small "total energy" systems that utilize waste heat to provide space heating and cooling are more energy-efficient than large power plants common today.

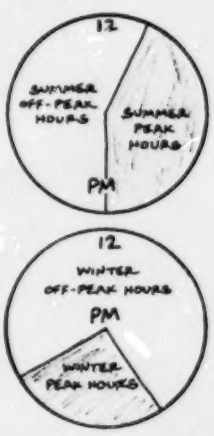
And some utilities are experimenting by showing customers how to save energy, and making small loans to them for energy-conserving home improvements.



REVISING RATE STRUCTURES

Electric rate structures often encourage high consumption (use more and pay proportionally less per kilowatt hour).

Revised rate structures can encourage conservation and reduce demand during peak periods. By leveling peak demand, fewer new power plants are needed, and the rising cost of power can be slowed.



NEEDED: A VARIETY OF SOLUTIONS

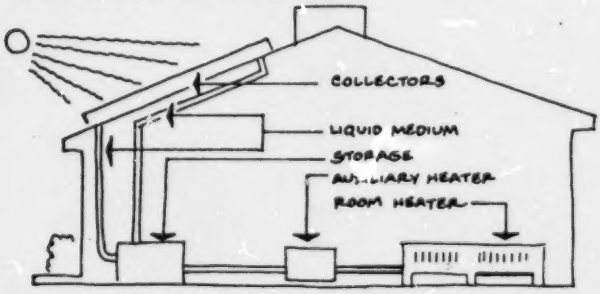
Aside from conservation, we need LONG-RANGE SOLUTIONS. There is probably no single solution to our energy problems – we have to get our energy from a variety of sources.

And, we should try to MATCH the KIND OF ENERGY with the particular NEED. It makes no sense, for example, to use nuclear power to heat water in homes when much-lower-temperature solar energy would do the job just as well.

Here are 6 promising alternatives--

❶ SOLAR HEATING

In many areas, it's already cost-competitive with electricity and oil. The sun can provide 50 to 80% of our home heating requirements. Tens of thousands of solar water and space heating systems are already operating. Solar heating is an alternative that's "here and now".

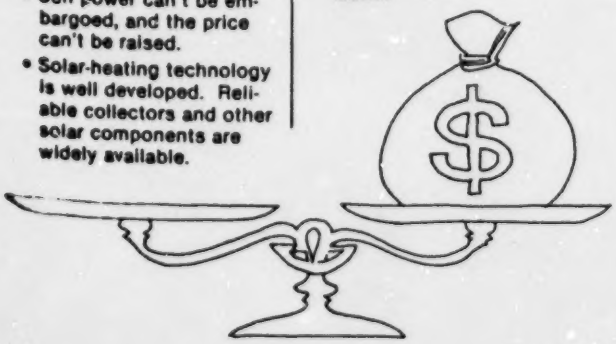


ADVANTAGES

- Operating costs after initial installation ($1,500 - $8,000) are minimal except for maintenance.
- Solar heating is nonpolluting: no noise and no wastes.
- Sun power can't be embargoed, and the price can't be raised.
- Solar-heating technology is well developed. Reliable collectors and other solar components are widely available.

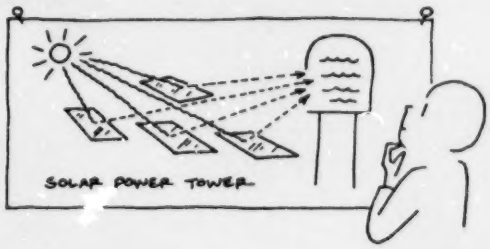
DISADVANTAGES

- Solar systems can be costly, particularly for existing homes. However, with tax incentives and the same subsidies given other sources, the cost of "solar" could come down.



❷ SOLAR ELECTRICITY

Central power stations can be fueled by the sun. One idea is the power tower. A large field of tracking mirrors follows the sun, focusing the rays on a boiler located on top of a tower. Superheated water in the boiler is turned to pressurized steam to drive a power turbine. Commercial plants of this type, able to generate 100 to 300 megawatts of electricity, may be operating by the mid-to-late 1980s.



ADVANTAGES

- Solar power plants consume no fossil fuels.
- They generate electricity cleanly, with no pollution.
- They involve none of the risks of nuclear power plants.

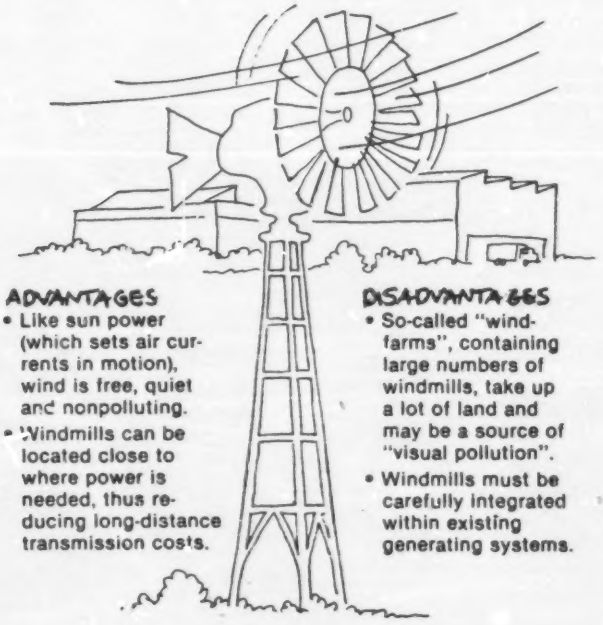
DISADVANTAGES

- Since a solar plant's concentrating mirrors require direct sunlight, they'll probably only be feasible in parts of the country where there are few cloudy days and little air pollution (such as the southwest).
- They can operate only during daylight hours – simply a fact of life that means they'll have to be backed up by conventionally produced power at night, at least until large-scale storage techniques are developed.
- Solar plants require a great deal of land.

③ WIND POWER

It's one of our oldest and best-understood energy sources. In areas where there are steady breezes, modern windmills can generate huge amounts of power.

Estimates are that we couid produce as much as one trillion kilowatts of electricity with wind power by the year 2000 -- about half of U.S. consumption in 1976.

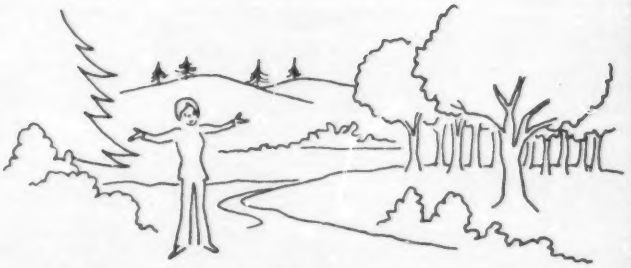


ADVANTAGES

- Like sun power (which sets air currents in motion), wind is free, quiet and nonpolluting.
- Windmills can be located close to where power is needed, thus reducing long-distance transmission costs.

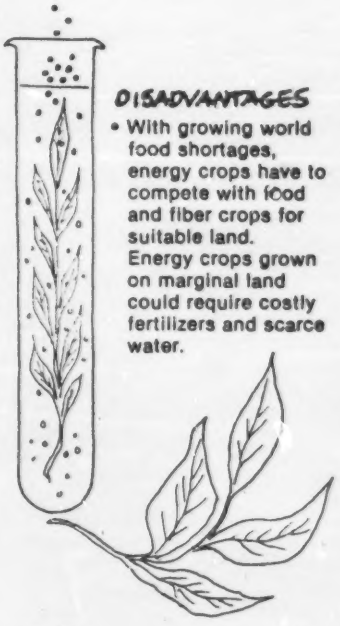
DISADVANTAGES

- So-called "windfarms", containing large numbers of windmills, take up a lot of land and may be a source of "visual pollution".
- Windmills must be carefully integrated within existing generating systems.



④ BIOMASS

Green plants collect and store solar energy through the process of photosynthesis. By burning plants, treating them biologically or chemically, this energy can be recovered in the form of heat, synthetic gas or liquid fuel (such as methanol). Biomass has long been a major source of fuel: much of the world depends on it in the form of wood and charcoal.



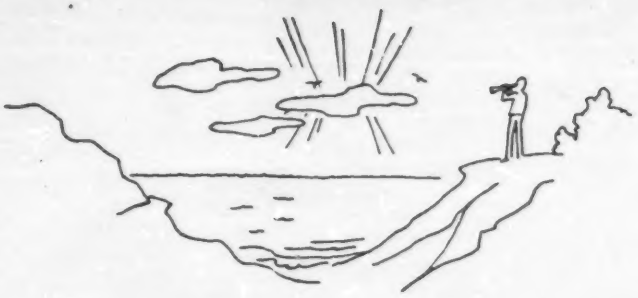
ADVANTAGES

- Organic wastes – wood chips, sugar cane residues, even municipal garbage – can be converted into bio-fuels.
- Bio-fuels such as methanol (an alcohol) may be the best substitute for oil to power our cars, trucks and buses. Moreover, such fuels are renewable.
- "Energy plantations" which raise fast-growing trees or other energy "crops" could be a major source of renewable energy.

DISADVANTAGES

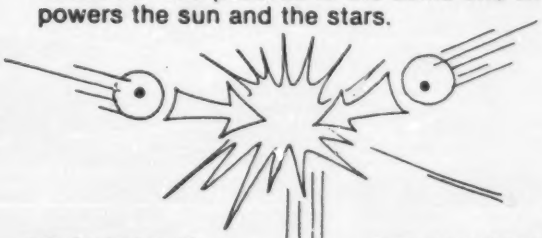
- With growing world food shortages, energy crops have to compete with food and fiber crops for suitable land. Energy crops grown on marginal land could require costly fertilizers and scarce water.

These and other promising, low-polluting energy sources have a significant and growing priority in the federal budget.



⑤ FUSION

This could be the ultimate answer to the energy problem. By fusing the nuclei of deuterium and tritium atoms, a vast quantity of energy can be released. The process is the same one which powers the sun and the stars.



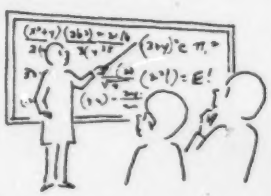
ADVANTAGES

- The cheap raw materials for fusion are found in seawater. There is enough deuterium in the oceans to supply the world with energy for billions of years.
- Fusion, unlike nuclear fission, uses no radioactive materials which can be converted into weapons. The process is inherently safe and poses little danger to the environment.
- The volume of radioactive waste produced is small, and the radioactivity is comparatively short-lived – again, in contrast to nuclear fission.

DISADVANTAGES

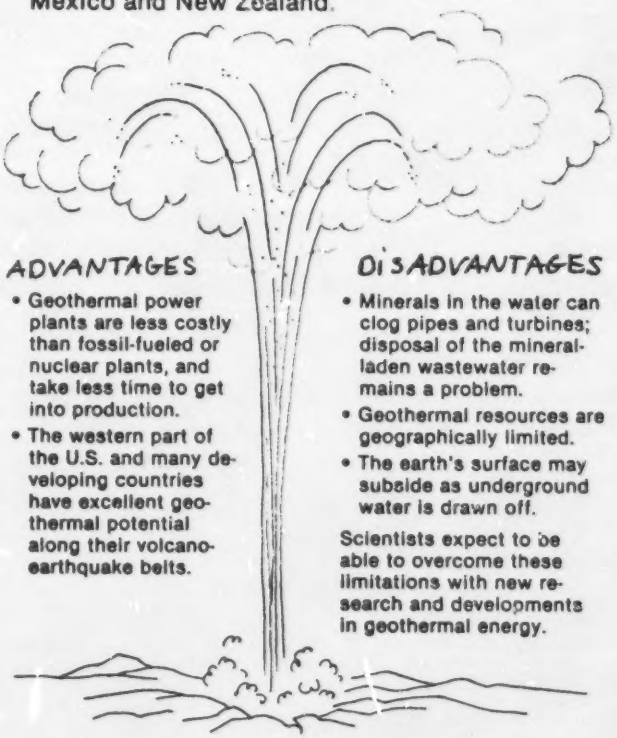
- The technical barriers that must be overcome are formidable. Translating the theoretical potential into practical reality will be a long and difficult job . . . and the results are uncertain.

Scientists hope to have a fusion plant operating by the late 1990s.



⑥ GEOTHERMAL POWER

Pressurized steam or boiling water is produced when water deep in the earth seeps over very hot rocks. This geothermal heat is being used today to generate electricity in California, Iceland, Italy, Mexico and New Zealand.



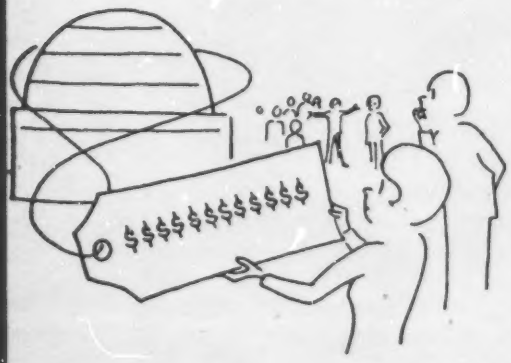
ADVANTAGES

- Geothermal power plants are less costly than fossil-fueled or nuclear plants, and take less time to get into production.
- The western part of the U.S. and many developing countries have excellent geothermal potential along their volcano-earthquake belts.

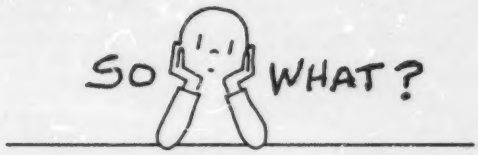
DISADVANTAGES

- Minerals in the water can clog pipes and turbines; disposal of the mineral-laden wastewater remains a problem.
- Geothermal resources are geographically limited.
- The earth's surface may subside as underground water is drawn off.

Scientists expect to be able to overcome these limitations with new research and developments in geothermal energy.



However, many experts feel that still more money should be invested. They believe, for example, that some of the huge funds committed to nuclear power would pay greater dividends if spent on these promising alternatives.



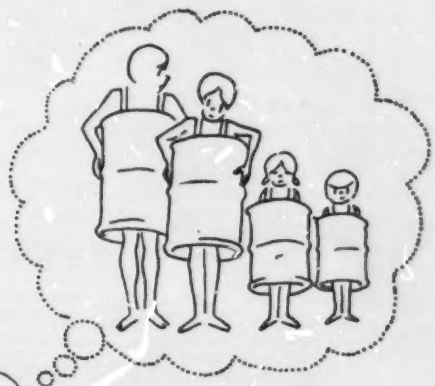
SOO--

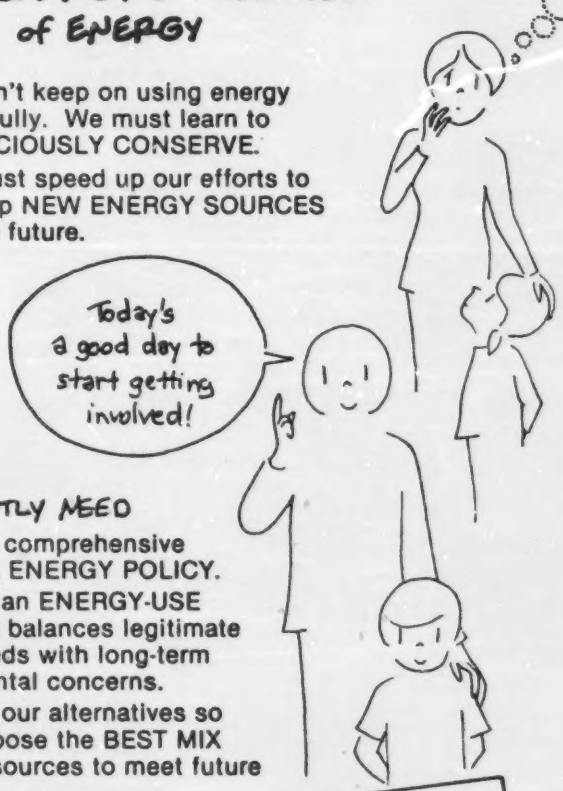
if we want to continue our present standard of living, we must

ADAPT OUR HABITS

to the **CHANGING REALITIES** of **ENERGY**

- We can't keep on using energy wastefully. We must learn to CONSCIOUSLY CONSERVE.
- We must speed up our efforts to develop NEW ENERGY SOURCES for the future.





WE URGENTLY NEED

- to create a comprehensive NATIONAL ENERGY POLICY.
- to develop an ENERGY-USE ETHIC that balances legitimate energy needs with long-term environmental concerns.
- to develop our alternatives so we can choose the BEST MIX of energy sources to meet future needs.

INDUSTRY MUST

- increase the efficiency of industrial processes.
- design more efficient transportation.
- develop more energy-efficient buildings.
- recycle waste materials.

GOVERNMENT MUST

- accelerate and devote more resources to a massive program to develop new, clean, renewable energy sources.
- provide incentives to encourage energy conservation and the development and commercialization of new energy-efficient technologies.

WE MUST

- practice energy conservation in our homes and daily lives.
- use fewer, more efficient appliances.
- shift to smaller, more efficient cars.
- make more use of mass transportation.
- become more conscious of where we use energy and determine how we can use less and use it more efficiently.

We have looming energy problems, but we still have time to make correct choices and solve the problems--

IF WE ACT NOW!

GLOSSARY of energy terms

barrel – A liquid measure of oil, usually crude oil, equal to 42 gallons or about 306 pounds.

base load – The minimum load of a utility (electric or gas) over a given period of time.

bioconversion – A general term describing the conversion of one form of energy into another by plants or micro-organisms. It usually refers to the conversion of solar energy by photosynthesis.

bio-fuel – A fuel derived from plant materials.

biomass – Plant materials in any form, from algae to wood.

British thermal unit (BTU) – An engineering unit of heat energy, the quantity of heat necessary to raise the temperature of one pound of water to one degree Fahrenheit.

catalytic converter – A device added to the exhaust system of an automobile that converts the air pollutants, carbon monoxide (CO) and hydrocarbons (HC), to carbon dioxide (CO_2) and water. A similar conversion also removes nitrogen oxides (NO_x).

chain reaction – A reaction that stimulates its own repetition. In a fission chain reaction a fissionable nucleus absorbs a neutron and splits in two, releasing additional neutrons. These in turn can be absorbed by other fissionable nuclei, releasing still more neutrons and maintaining the reaction.

coal gasification – The conversion of coal to a gas suitable for use as fuel through the application of heat and pressure.

coal liquefaction – The conversion of coal into liquid hydrocarbons, usually by the addition of hydrogen.

crude oil – A mixture of hydrocarbons in liquid form found in natural underground petroleum reservoirs. It has the heat content of 1.46 million calories per barrel and is the raw material from which most refined petroleum products are made.

declining block rate – A method of charging for electricity whereby a certain number of kilowatt hours (the first block) is sold at a relatively high rate and succeeding blocks at lower and lower rates. Thus the charge for energy decreases as the amount consumed increases.

deuterium – A non-radioactive isotope of hydrogen whose nucleus contains one neutron and one proton; is therefore about twice as heavy as the nucleus of normal hydrogen which consists of a single proton. Deuterium is often referred to as "heavy hydrogen."

efficiency – The efficiency of an energy conversion is the ratio of the useful work or energy output to the total work or energy input.

energy – A quantity having the dimensions of a force times a distance. It is conserved in all interactions within a closed system. It exists in many forms and can be converted from one form to another. Common units are calories, joules, BTU's and kilowatt-hours.

fission – The splitting of heavy nuclei into two parts (which are lighter nuclei), with the release of large amounts of energy and one or more neutrons.

fluidized bed – A furnace design in which the fuel is buoyed up by air and some other gas. It offers advantages in the removal of sulfur during combustion.

fossil fuels – Fuels such as coal, crude oil, or natural gas, formed from the fossil remains of organic materials.

fusion – The formation of a heavier nucleus by combining two lighter ones.

generating capacity – The capacity of a power plant to generate electricity, usually measured in megawatts (MW).

geothermal energy – The heat energy in the earth's crust whose source is the earth's molten interior. When the energy occurs as steam, it can be used directly in steam turbines.

greenhouse effect – The warming effect of carbon dioxide and water vapor in the atmosphere. These molecules are transparent to incoming sunlight but absorb and reradiate the infrared (heat) from the earth.

heat pump – A device that transfers heat from a cooler area to a warmer one (or vice versa) by the use of mechanical or electric energy. Heat pumps work on the same general principle as refrigerators and air conditioners.

horsepower – Originally, the power output of a typical working horse. Equal to 3/4 of one kilowatt or 0.18 calories per second.

hot rock reservoir – A potential source of geothermal power. The "hot rock" system requires drilling deep enough to reach heated rock and then fracturing it to create a reservoir into which water can be pumped.

hydrocarbons – Molecules composed of carbon and hydrogen atoms in various proportions. They are usually derived from living materials.

inverted block rate – A method of selling electricity whereby a first block of kilowatt hours is offered at low cost and prices increase with higher consumption.

kilowatt (kw) – A unit of power, usually used for electric power, equal to 1,000 watts.

kilowatt-hour (kw-hr) – A unit of work or energy. Equivalent to the expenditure of one kilowatt in one hour, about 853 calories.

lifetime energy cost – Cost of energy required to operate any energy-converting device during its lifetime.

liquefied natural gas (LNG) – Natural gas that has been cooled to approximately minus 160° centigrade, a temperature at which it's liquid. Since liquefaction reduces the volume of the gas some 600 times, the costs of storage and shipment are reduced.

load factors – The percentage of capacity actually utilized; for example, the average number of passengers for a certain size car divided by the passenger capacity of that size car.

megawatt (mw) – A unit of power. A megawatt equals 1,000 kilowatts, or 1 million watts.

methane gas – A light hydrocarbon; an inflammable natural gas with a heat value of 275 calories/cubic feet. It is the major component of natural gas but can be manufactured from crude oil or other organic materials.

methanol – A volatile, water-soluble, flammable liquid alcohol.

net energy – The amount of energy produced minus the energy needed to produce it.

nuclear energy – The energy released during reactions of atomic nuclei.

nuclear reactor – A device in which a fission chain reaction can be initiated, maintained and controlled.

nucleus – The extremely dense, positively charged core of an atom. It contains almost the entire mass of an atom, but fills only a tiny fraction of the atomic volume.

ocean thermal energy conversion (OTEC) – A process of generating electrical energy by harnessing the temperature differences between surface waters and ocean depths.

"off-peak" power – Power generated during a period of low demand.

oil shale – A sedimentary rock containing a solid organic material called kerogen. When oil shale is heated at high temperatures, the oil is driven out and can be recovered.

passenger mile – The measure used to state the amount of BTU energy needed to carry one passenger for one mile.

peak demand period – That time of day when the demand for electricity from a power plant is at its greatest.

peak load – The maximum amount of power delivered during a stated period of time.

peak load pricing – Charging more for delivery of power during the daily period in which demand is greatest.

petroleum – An oily, flammable liquid that may vary from almost colorless to black and occurs in many places in the upper strata of the earth. It is a complex mixture of hydrocarbons and is the raw material for many products.

photosynthesis – The process by which green plants convert radiant energy (sunlight) into chemical potential energy.

photovoltaic process – The process by which solar energy is converted directly into electrical energy. Solar radiation striking certain materials is absorbed, causing separation of electrons from atoms. The migration of these electrons in one direction and of the positively charged electron vacancies ("holes") in the other can produce a small potential difference or voltage, typically about 0.5 volts.

power – The rate at which work is done or energy expended. It is measured in units of energy per unit of time such as calories per second, and in units such as watts and horsepower.

recoverable resource – That portion of a resource expected to be recovered by present-day techniques and under present economic conditions. Includes geologically expected but unconfirmed resources as well as identified reserves.

reserve – That portion of a resource that has been actually discovered but not yet exploited and is presently technically and economically extractable.

secondary recovery – Recovery techniques used after some of the oil and gas has been removed and the natural pressure within the reservoir has decreased.

solar cell – A device which converts radiant (solar) energy directly into electrical energy by the photovoltaic process. Each cell produces about 0.5 volts and about 0.6 watts of power.

solar energy – The electromagnetic radiation emitted by the sun. The earth receives about 4,200 trillion kilowatt-hours per day.

stack gas scrubber – Device which removes sulfur dioxide from gases produced by coal combustion.

synthetic natural gas (SNG) – A gaseous fuel manufactured from coal. It contains almost pure methane, and can be produced by a number of coal gasification techniques.

synthetic oil– Oil produced from liquefaction of coal.

tar sands – Sandy substance mixed with low-grade oil.

tertiary recovery techniques – Use of heat and other methods to augment oil recovery (presumably occurring after secondary recovery).

thermal storage – A system which utilizes ceramic brick or other materials to store heat energy.

thermodynamics – The science and study of the relationship between heat and other forms of energy.

ton-mile – The term used in measuring the amount of BTU energy needed to haul one ton one mile.

topping cycle – A way to use high temperature heat energy that cannot be used in a conventional steam turbine. A gas turbine, for instance, might operate as a topping cycle on furnace gases of 2000° F and its exhaust could then heat steam for a turbine operating at 1000° F.

total energy system – Energy system using either high-efficiency gas-fired turbines or engines which generate electricity; exhaust heat from the turbines or engines is used for heating or cooling.

tritium – A radioactive isotope of hydrogen with a half-life of 12.5 years. The nucleus contains one proton and two neutrons. It may be used as a fuel in the early fusion reactors.

uranium – A heavy, naturally occurring, radioactive nucleus of atomic number 92. Uranium isotope 235_U is used as fission fuel.

watt – A metric unit of power usually used in electric measurements which gives the rate at which work is done or energy expended.

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ABOUT THE NATIONAL WILDLIFE FEDERATION

The National Wildlife Federation is a private, nonprofit conservation education organization, publicly but not governmentally supported. It aims to inform our citizens concerning the wise management of our natural resources and the importance of a clean environment for man and the other inhabitants of Earth.

One way to do this is by circulating, free in single copies, the many conservation education publications which we produce. People often respond by asking, "What can I do to help?"

One of the best things you can do is to keep an eye on local, state, and federal government actions that might affect the environment. Learn the facts and make your views known in every forum available. You will be doing the environment — *your* environment — a favor.

Something else you can do: join an organization such as the National Wildlife Federation. As a conservation education organization, the Federation is working for a better environment for man and wildlife. If you would like information on becoming a member, please write to us.